

NISTIR 6242

ANNUAL CONFERENCE ON FIRE RESEARCH
Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

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Aircraft Hangar Fire Protection System Evaluation Full Scale Fire Test Report

by

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Current Navy design standards for protecting large aircraft hangars include both overhead and low level aqueous film forming foam (AFFF) extinguishing systems [1]. The overhead AFFF system typically consists of standard closed head sprinklers that are zoned within areas defined by draft curtains. In some existing installations, the overhead systems are open head deluge systems. The low level system typically consists of multiple high flow monitors (e.g., 1893 Lpm (500 gpm)). The low level AFFF and overhead deluge sprinkler systems are activated by separate detection systems (heat detection or UV/IR).

Due to high costs incurred from damage of aircraft and electronics resulting from accidental discharges of the overhead AFFF system, the Navy is exploring alternate suppression techniques. The proposed approach would replace the overhead foam suppression system with a closed-head water sprinkler system. The ground level AFFF delivery system would become the primary means of fire suppression, and the overhead sprinklers would be used to cool adjacent aircraft and protect the structural integrity of the hangar. The time delay in activating the overhead system would also be minimized through the use of quick response sprinklers. This time delay has already been quantified in previous studies [2].

The Navy initiated this investigation to evaluate the capabilities of an aircraft hangar fire suppression system consisting of a low level AFFF extinguishing system and an overhead water sprinkler system. A future investigation will determine the capabilities of a proposed low level AFFF system that would eliminate high flow foam monitors, using instead, numerous lower flow nozzles mounted very close to the hangar floor.

Twenty three full-scale fire tests were conducted in the large burn building at Underwriters' Laboratories, Inc. (UL) to evaluate the effects of overhead water sprinklers on AFFF foam blankets. One AFFF application rate (4.0 Lpm/m² (0.1 gpm/ft²)) and two sprinkler application rates were included in this evaluation (6.5 and 10.2 Lpm/m² (0.16 and 0.25 gpm/ft²)). The tests were conducted against a range of spill fire scenarios. The spill fires were produced using either JP-5 or JP-8 aviation fuels and were evaluated on a concrete pad with similar drainage characteristics of typical Navy hangars.

The results show that the use of water sprinklers (with application rates up to 10.2 Lpm/m² (0.25 gpm/ft²)) in conjunction with a low level AFFF fire suppression system (with an application rate of 4.0

Lpm/m² (0.1 gpm/ft²)) had minimal effects on the ability of the system to suppress the fire and resist burnback. In all tests, the low level AFFF system was capable of quickly extinguishing the test fire (control ~ 30 sec and extinguishment ~ 1:00) independent of the sprinkler application rate. The time required for the fire to burnback across the fuel surface was apparently a function of the drainage characteristics of the hangar and was only slightly affected by the application of water through the overhead sprinklers. The tests also show that the flashpoint of the fuel has minimal effect on the control and extinguishment capabilities of the system but had a greater effect on the burnback capabilities of the system. Although the burnback times for the lower flashpoint fuels were faster than the higher flashpoint fuels, the duration of protection was not significantly altered. In summary, these tests show that overhead water sprinklers (with application rates up to 10.2 Lpm/m² (0.25 gpm/ft²)) have minimal effect on AFFF foam blankets, independent of the test fuel, fire scenario, and sprinkler application rate. The tests show that a combined low level AFFF extinguishing system operating in conjunction with an overhead water sprinkler system will provide adequate protection for the hangar during AFFF discharge but the protection in terms of burnback resistance, may be lost shortly (a few minutes) after the end of AFFF discharge.

In conclusion, the data show that a low level AFFF system alone can achieve rapid fire control and extinguishment without the use of overhead sprinklers. This is consistent with data in the literature [3]. In these tests, with the nozzles adjusted/positioned in a less-than-optimum configuration, control times ranged from 20-40 sec, and total extinguishment of the spill fire was generally achieved in 60 seconds. This is consistent with the requirements of NFPA 409 design objectives of 30 sec for control and 60 sec for extinguishment after system activation [4]. It has been demonstrated that the operation of overhead water sprinklers does not degrade the performance of the low level system during AFFF discharge. Design criteria for Navy hangar protection can be revised to incorporate AFFF application from only the low level system, combined with overhead closed head quick response water sprinklers.

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